March 1, 1966 J. L. HAYDU 3,238,341

MODULAR ELECTRICAL CONTACT ASSEMBLY

Filed Dec. 26, 1963 3 Sheets-Sheet 1

Fig. 1

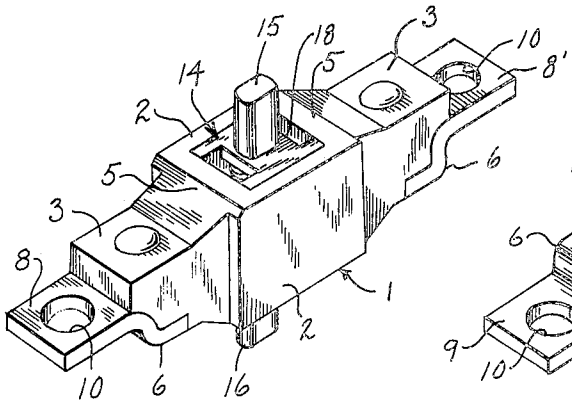


Fig. 2

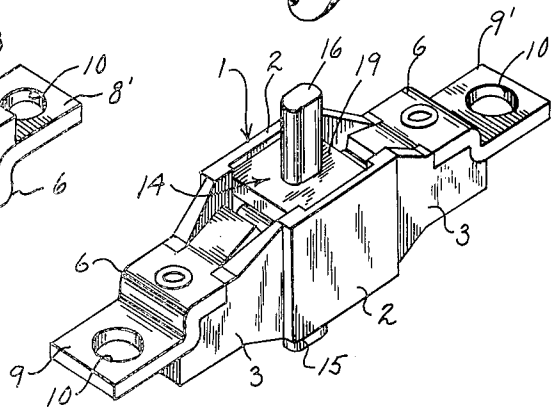


Fig. 3

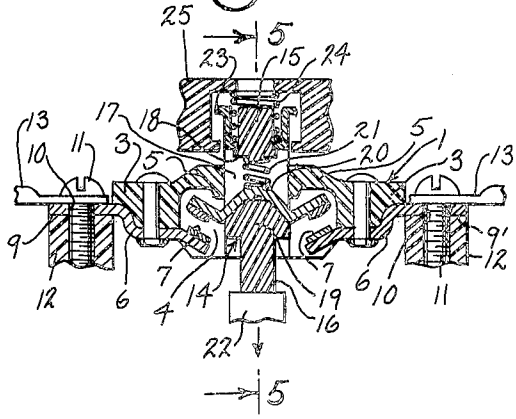


Fig. 4

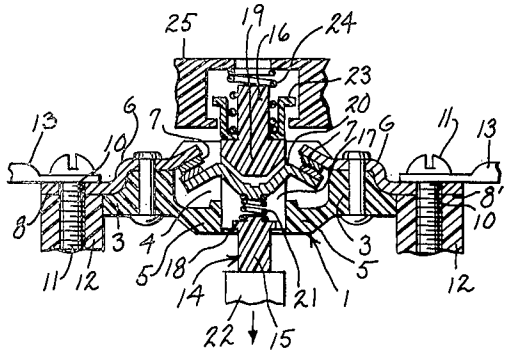
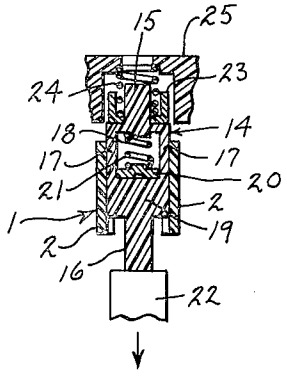


Fig. 5



INVENTOR
JOHN L. HAYDU

BY Arthur H. Seidel
ATTORNEY

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MODULAR ELECTRICAL CONTACT ASSEMBLY

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Fig. 6

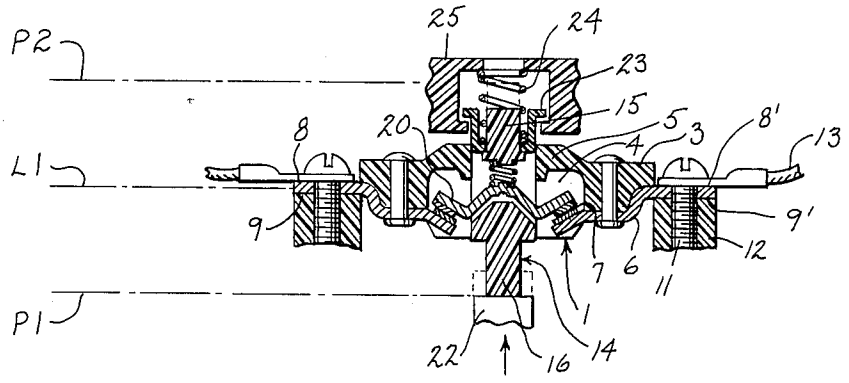


Fig. 7

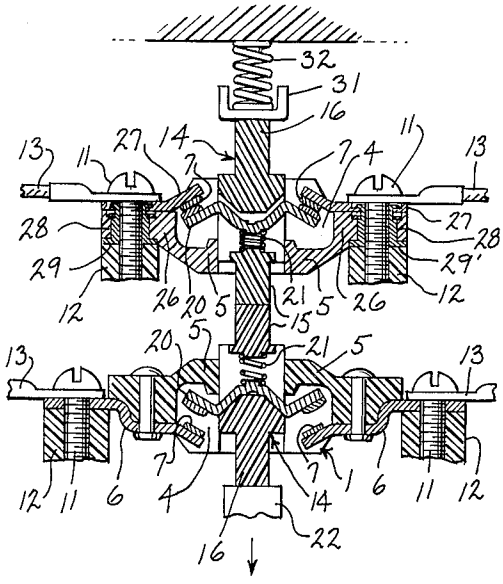
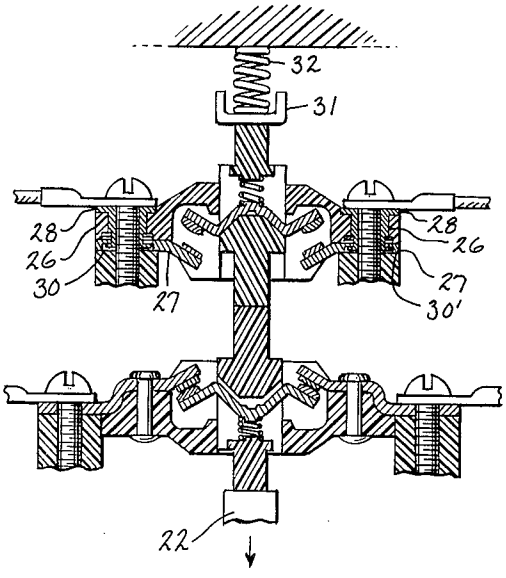


Fig. 8



INVENTOR
JOHN L. HAYDU

BY Arthur W. Fuller

ATTORNEY

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MODULAR ELECTRICAL CONTACT ASSEMBLY

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Fig. 9

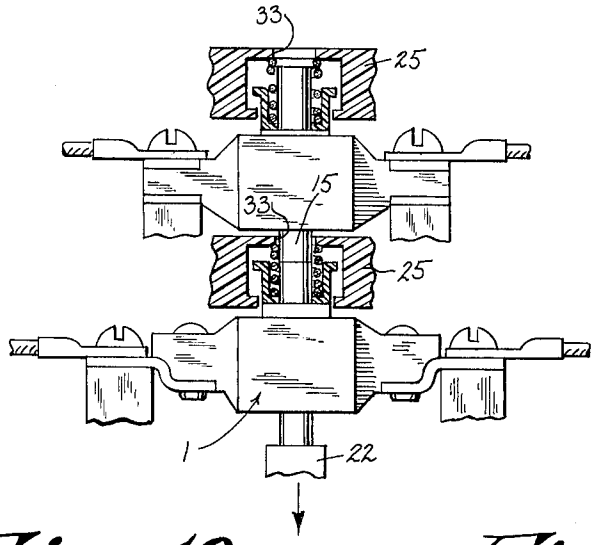


Fig. 10

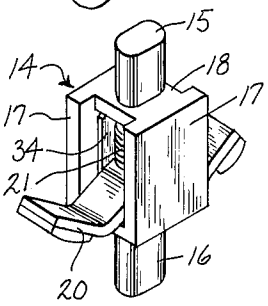


Fig. 11

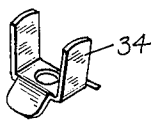


Fig. 12

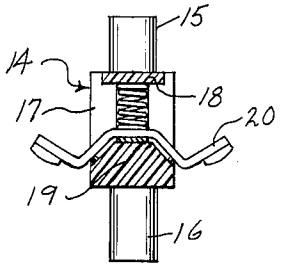
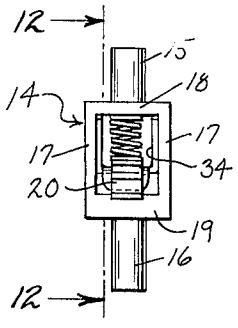


Fig. 13



INVENTOR
JOHN L. HAYDU

BY Arthur H. Fiddle

ATTORNEY

United States Patent Office

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Patented Mar. 1, 1966

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3,238,341

MODULAR ELECTRICAL CONTACT ASSEMBLY

John L. Haydu, Milwaukee, Wis., assignor to Allen-Bradley Company, Milwaukee, Wis., a corporation of Wisconsin

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6 Claims. (Cl. 200—166)

This invention relates to a modular contact assembly for use in electrical controls and it more specifically resides in an assembly having a housing with stationary contacts fixed thereon, a reciprocably movable contact carrier mounted in the housing which supports movable contacts adapted for engagement with the stationary contacts, and mounting surfaces that permit for inversion of the assembly to have the contacts assume either normally open or normally closed positions.

There has been a continued effort to improve contact structures in electrical relays and other control switches. Particularly, efforts have been directed toward producing a reversible type of contact arrangement in which there may be a conversion to either a normally open or a normally closed contact condition. In most instances, the structures developed involve arrangements whereby a movable bridging contact can be manipulated, so as to be either normally open or normally closed with respect to stationary contacts anchored to the switch housing, such as is shown, for example, in Patents Nos. 2,985,736, 2,919,327 and 2,773,948. In these structures it has usually been necessary to also make a separate removal and reinsertion of a stationary contact in order to complete the inversion from one contact condition to the other.

It has also been suggested to incorporate the stationary and movable contacts in a common assembly, and to invert the entire assembly as a unit for converting between normally open and normally closed conditions, such as shown, for example, in Patent No. 3,105,128. The present invention is of this latter type, and it provides an improved invertible contact assembly that is preferably mounted by its terminal screws, so that removing and reversing the assembly requires little more effort than connecting it into the circuit of which the contacts are to be a part. Hence, a single manipulation of the screws and the assembly accomplishes both the mounting and the making of circuit connections. Moreover, if a malfunction occurs in an assembly, it is easily remedied by simply replacing that assembly, and of course, it makes no difference in the repair procedure whether the malfunction results from defects in the movable or in the stationary contacts. Accordingly, it is an object of the invention to provide an easily removable contact assembly for electrical control switches and circuits.

It is another object to provide a contact assembly that can be used in multiples to meet a variety of circuit requirements. It thus functions as a modular building unit for switches, and the term module is applied herein to the assembly to designate this characteristic.

It is another object of the invention to provide a self-contained contact module including stationary as well as bridging contacts and terminals for electromagnetic control switches.

It is a further object to provide a contact module that may be tiered one above another in a manner that individual operating springs can be incorporated for each module.

It is another object of the invention to provide a reversible contact module that is adapted for use in a variety of control switches.

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The foregoing and other objects will appear from the description to follow. In the description, reference is made to the accompanying drawings which form a part hereof and in which there is shown by way of illustration specific embodiments in which this invention may be practiced. These embodiments will be described in sufficient detail to enable those skilled in the art to practice the invention, but it is to be understood that other embodiments of the invention may be used and that structural changes may be made in the embodiments described without departing from the scope of the invention. Consequently, the following detailed description is not to be taken in a limiting sense; instead, the scope of the present invention is best defined by the appended claims.

In the drawings:

FIG. 1 is a view in perspective of a contact module embodying the present invention,

FIG. 2 is another view in perspective of the module of FIG. 1, but inverted in position from that shown in FIG. 1,

FIG. 3 is a side view in section of the module of FIG. 1 showing the contacts in a normally open condition and including operating mechanism associated with the module,

FIG. 4 is a side view in section of the module inverted from the position of FIG. 2 to have the contacts in a normally closed position,

FIG. 5 is a view in section taken in the plane 5—5 designated in FIG. 3,

FIG. 6 is a side view in section of the module oriented as in FIG. 3, and with the contacts moved into closed position,

FIG. 7 is a side view in section of two contact modules in tiered relation with the lower module being like the embodiment in FIGS. 1–6, and the upper module being a second embodiment mounted with its contacts normally closed,

FIG. 8 is a side view in section of the tiered arrangement shown in FIG. 7, with each of the contact modules being inverted,

FIG. 9 is a side view of a second group of tiered modules similar to those in FIG. 7, except that the operating springs are in an alternative form,

FIG. 10 is a view in perspective of a movable contact carrier and contact spanner like those in the various preceding embodiments, but modified by the inclusion of a liner,

FIG. 11 is a view in perspective of a liner that may be used in the movable contact carrier forming a part of the invention, and which is included in the contact carrier of FIG. 10,

FIG. 12 is a view in section of the movable contact carrier of FIG. 10 viewed through the plane 12—12 designated in FIG. 13, and

FIG. 13 is an end view of the movable contact carrier of FIG. 10.

Referring now to the drawings, FIGS. 1 through 5 illustrate one preferred embodiment of the contact module of the present invention. This module has a housing 1, molded from a suitable insulating material, comprising a pair of identical spaced side walls 2 joined by a pair of like ends 3 to define a contact chamber 4 that is open at both the top and bottom. Each end 3 includes an inwardly extending stop wall 5 that lies between the side walls 2, to close off a portion of the contact chamber 4. These

stops 5 are at the top of the housing 1 in FIGS. 1, 3 and 6, and at the bottom of the housing 1 in FIGS. 2 and 4. The same housing 1 is depicted in each of these FIGS. 1–6, but in FIGS. 2 and 4 it is inverted, or upside down, from the orientation in the other figures, for the purpose of altering the normal position of the contacts, as will hereinafter be discussed.

Metal terminal strips 6 are riveted on the housing ends 3 which include stationary contacts 7 projecting into the contact chamber 4 in positions opposite the stop walls 5 to have a gap therebetween in which movable contacts may reciprocate. The outer ends of the terminal strips 6 extend out beyond the housing ends 3 to present mounting surfaces 8 and 8′ facing one direction, as particularly seen in FIG. 1, and mounting surfaces 9 and 9′ facing the opposite direction, as seen in FIG. 2. Mounting holes 10 are formed in the outer ends of the terminal strips 6 which pierce the mounting surfaces 8, 8′, 9 and 9′, and through which terminal screws 11 may pass to anchor the contact module to a suitable support, such as represented by the posts 12. The terminal screws 11 also serve to connect circuit conductors, such as indicated by the reference numerals 13, to the terminal strips 6.

Inside the contact chamber 4 is a vertically movable contact carrier 14 that fits in suitable recesses in the side walls 2, so that reciprocating movement of the contact carrier 14 is guided in a straight line motion. For the description of the contact carrier 14 reference is also made to FIGS. 10, 12 and 13. It is a unitary member molded from a satisfactory material which can be a phenolic condensation product, a nylon or other material, and it is box like in form with an actuator stem 15 extending from one end and a longer second actuator stem 16 extending from the opposite end. The central box like section has a pair of spaced, upright guide walls 17 joined at their top and bottom by a cross rib 18 that functions as a spring seat and by a saddle like rib 19 that functions as a movable contact seat. The upright guide walls 17, the cross rib 18 and the saddle rib 19 form a contact cage having a lateral opening that receives a movable contact spanner 20 and a contact bias spring 21. The spring is inserted between the spring seat formed by the cross rib 18 and the back of the contact spanner 20, to urge the spanner 20 against the saddle 19, and to create contact pressure with the stationary contacts 7 when the contacts are brought into engagement. The saddle 19 has a convex configuration, and the contact spanner 20 is arched to conform with this configuration.

The ends of the movable contact spanner 20 project out from the contact carrier 14 into positions facing the stationary contacts 7, and they are captive between the stationary contacts 7 and the stop walls 5, to thereby retain the entire movable contact assembly as a part of the module. Thus, the guide walls 17 of the contact carrier 14 are held in sliding relation with the recessed side walls 2 of the housing 1, and they also guide the movable contact spanner 20 in its motions toward and from contact closure with the stationary contacts 7.

Referring now to FIGS. 3, 5 and 6, the end of the lower actuator stem 16 rests upon a switch operator 22, which can be part of an electromagnet, a mechanically driven cam, or any other device that is to operate the contact module of the invention. The operator 22 is in a raised, normal position in FIGS. 3 and 5, and in FIG. 6 it is shown in a lowered position. Encircling the upper actuator stem 15 is a cup shaped collar 23 which receives the lower end of an operating spring 24. The other end of the spring 24 seats against the ceiling of a spring compartment 25, which together with the collar 23 and operating spring 24 are a part of the same device as the switch operator 22. The bottom end of the collar 23 bears against the cross rib 18 to urge the carrier 14 downward against the operator 22, and by having the actuator stem 15 of smaller cross section than the cage portion of the carrier 14 a shoulder is formed on the rib 18 against which the collar 23 may bear.

With the operator 22 in its raised position the contact carrier 14 is likewise in its highest position, thus holding the movable contact spanner 20 above and out of engagement with the stationary contacts 7. The contact bias spring 21 retains the contact spanner 20 against the saddle 19, and the operating spring 24 is compressed upward.

When the operator 22 is drawn downward into the position shown in FIG. 6 the operating spring 24 forces the contact carrier 14 downward. This movement carries the movable contact spanner 20 into engagement with the stationary contacts 7, and an overtravel of the carrier 14 will disengage the contact spanner 20 from the saddle 19, whereby the contact bias spring 21 will establish contact pressure. The closed contact position of FIG. 6 is now obtained.

To convert the contact module to normally closed contacts, one merely turns the module upside down into the position shown in FIGS. 2 and 4. In this position, the actuator stem 15 extends downward to abut upon the operator 22, which in its normal high position forces the carrier 14 upward to have the movable contact spanner 20 engage the stationary contacts 7. The contact bias spring 21 will be compressed to support the movable contact spanner 20 and to develop contact pressure. The operating spring 24 seated in the collar 23 is also compressed upward. To open the normally closed contacts, the operator 22 is moved downward, and the operating spring 24 will expand to move the contact carrier 14 downward in unison with the operator 22.

It should be noted that if the normal position of the operator 22 is its lower position, then the orientation of the module in FIG. 3 will be such as to have normally closed contacts, since FIG. 6 will then represent the normal position. Similarly, an inversion into the orientation of FIG. 4 will place the module in a normally open condition, if the normal position of the operator 22 is its lower position.

The reversibility of the contact module is made possible by the fact that the end of the downwardly pointed actuator stem 15 or 16 occupies the same position atop the operator 22. It follows that the upwardly pointed actuator stem 15 or 16 will also assume the identical position. As a consequence, in an inversion of the contact module the movable contact carrier 14 is inverted about a horizontal axis midway between the uppermost position that will be assumed by the upper actuator stem (15 or 16) and the lowermost position that will be assumed by the lower stem (15 or 16). This relationship is shown in FIG. 6, wherein the lowermost position of a stem end is in the plane P1, and the uppermost position of the upper stem is in the plane P2. These reference planes are referred to herein as the extreme positions of the stem ends of the contact carrier 14. The axis of inversion for the contact carrier 14 is the line L1, perpendicular to the direction of motion of the contact carrier 14. By a careful placement of the mounting surfaces 8, 8′ and 9, 9′ relative to the line L1 the entire contact assembly is rendered invertible. For this placement, the mounting surfaces on one side 8, 8′ are spaced the same distance from the line L1 as the mounting surfaces 9, 9′ on the other side. Then, the line L1 constitutes an axis of rotation for the entire unit, such that when the unit is rotated about it the contacts will assume the correct normally open or normally closed position.

In the embodiments shown, the imaginary reference line L1 bisects the housing 1, because the lengths of the actuator stems 15, 16 are so balanced, and the position of the fixed contacts 7 is so designed to achieve that arrangement. However, for use in a different environment, it may be advantageous to change the lengths of the actuator stems 15, 16 and it is conceivable that their lengths

would vary to such a degree that the imaginary axis line L1 could lie wholly outside of the housing 1. Even in that case, if the mounting surfaces 8, 8' and 9, 9' are positioned parallel to and equidistant from the axis line L1 the unit will be reversible. If it is not practicable to so space the mounting surfaces, the same result could be achieved by providing separate supporting posts, one set of supporting posts to be used when the contact module is in a normally open contact position and another set to be used when the contact module is in a normally closed contact position.

FIGS. 7 and 8 illustrate another facet of the present invention that lends versatility to its use. Referring first to FIG. 7, two contact modules are arranged in a tiered fashion, one above the other, to be actuated by the same operator 22. The lower module is the same as that in FIGS. 1–6, and the upper module is a second embodiment similar in form, except that the mounting surfaces are inward of those of the lower module to adequately expose all the terminal screws 11.

In the second embodiment, parts identical with those described in the first embodiment of FIGS. 1–6 have the same reference numerals, and no further description need be given. However, the end portions 26 of the housings are of different configuration than the ends 3 of the housing 1 in FIGS. 1–6. This is to accommodate the mounting of terminal strips 27 that have short outer ends. The terminal strips 27 are anchored to the ends 26 by means of hollow rivets 28 which present mounting holes for the associated terminal screws 11. The rivets 28 present mounting surfaces 29 and 29' on one side of the housing and the terminal strips 27 provide mounting surfaces 30 and 30' on the opposite side of the housing. Also, the rivets 28 are in electrical engagement with the terminals 27, so that they function as a part thereof. The positioning of the surfaces 29, 29' and 30, 30' with respect to an axis of inversion is the same as that described hereinabove for the first embodiment. Hence, the surfaces 29, 29' are the same distance from an axis line midway between the extreme positions of the actuator stem ends as are the surfaces 30, 30'.

To complete the assembly a spring cup 31 rests upon the upper end of the upper actuator stem 16 and receives an operating spring 32, which urges both the upper and lower contact carriers in a downward direction. In mounting the tiered modules the lower actuator stem 15 of the upper module abuts upon the upper actuator stem 15 of the lower module, so that the two contact carriers 14 are driven by a single operator 22 and the single operating spring 32.

The modules in FIG. 7 are each reversible, so they may each be arranged to provide either normally open or normally closed contacts as desired, and as particularly shown in FIG. 7 the lower module has normally open contacts, since its actuator stem 16 abuts on the operator 22, which in its normal position pushes the contact carrier 14 upward to disengage the contacts. The upper module is mounted to provide normally closed contacts, its actuator stem 15 being on the lower side and in abutment with the upward projecting actuator stem 15 of the lower module, so that the actuator stem 15 of the lower module holds the contact carrier 14 of the upper module raised to place its contacts in closed position. The actuator stem 16 of the upper module, in turn, projects upward against the cup 31 to compress the operating spring 32. Hence, when the operator 22 is lowered the spring 32 moves both contact carriers 14 downward to open the upper contacts and close the lower contacts.

In FIG. 8, both of the modules are inverted from their positions in FIG. 7, so that the lower module provides normally closed contacts and the upper module provides normally open contacts. The operation is then exactly reversed from that described in connection with FIG. 7. Although it is not illustrated in the drawings, it is clear that both modules could be arranged to provide normally closed contacts, or both could be arranged to provide normally open contacts.

Modules arranged one above the other can also have individual operating springs, as shown in FIG. 9, instead of a sole operating spring 32 as shown in FIGS. 7 and 8. The parts in FIG. 9 are like that in FIGS. 3–6, and like reference numerals are applied. The lower operating stem 15 of the upper module passes through the opening 33 in the lower spring compartment 25, so that the contact carriers engage one another and the operating spring assemblies are concentric with the stems of the carriers. This construction, in which stems of relatively small cross section extend from the contact carriers 14, provides working shoulders on the carriers 14 which the concentric operating springs may work against, so that one module may be tiered above another. This particular feature, of individual operating springs, also provides for uniform working forces for each module regardless of the number stacked above one another. An example of the usefulness of this construction is illustrated in the copending application Serial No. 333,596, entitled Electromagnetic Relay.

Referring now to FIGS. 10–13, there is shown a modification to the contact carrier 14 in which a formed metal liner 34 is fitted within the transverse opening between the guide walls 17. The liner 34 covers the arched saddle-rib 19 and the inside surfaces of the walls 17. The movable contact spanner 20 is then guided by metal parts, which permit the manufacture of the carrier 14 to be from a resin such as nylon having non-brittle, tough qualities, but which may not be entirely desirable for withstanding the abrasive wear between the contact spanner 20 and the inner faces of the guide walls 17.

As is evident from the foregoing description and drawings, the present invention provides a highly versatile modular contact assembly that is completely reversible, so as to provide normally open or normally closed contacts at the desire of the user. Only a minimum of effort is required to make the conversion. Also, a module of the present invention provides a very substantial improvement in the speed and ease with which contacts may be replaced for routine maintenance, or added to a bank of contacts for building up control circuits and the like. Having the terminals and the contacts confined in a self-contained module effectively separates the contacts from the actuating means, to provide greater versatility in the use of the contacts for a variety of switching applications.

I claim:

1. In a contact module the combination comprising:
- a housing including a pair of spaced side walls, a pair of end portions joining said side walls that have a depth less than the height of said side walls, and a pair of stop walls at the bottom extending inward from the end portions to define a contact chamber open at the top and with a lesser opening at the bottom;
- a conductive terminal mounted on the top of each end portion with a stationary contact spaced from and facing one of said stop walls;
- a slidable contact carrier mounted between said side walls and through the lesser opening at the bottom for guided, reciprocating movement in the direction extending between said open top and bottom, said carrier having a contact cage with a lateral opening, a saddle rib forming a movable contact seat at its end closest to said stationary contacts, and a spring seat at its opposite end;
- a pair of operating stems each extending from an end of said contact carrier and having a cross section reduced from that of the carrier to present a shoulder adapted to engage an operating spring;
- a movable contact spanner mounted in said lateral opening of said contact carrier and movable toward and from said contact seat, which contact spanner has a curved center portion that mates with said

saddle rib and ends extending from the contact carrier which are inserted between said stop walls and said stationary contacts to bridge said stationary contacts upon engagement therewith and to move between contact closed and contact open positions upon reciprocation of said contact carrier;

a contact bias spring mounted in the contact cage of said contact carrier between said spring seat and said movable contact spanner to urge said saddle rib of the spanner against said movable contact seat;

and a pair of conductive mounting surfaces forming upper and lower sides of each terminal with are disposed outward of said end portions with the surfaces of a pair of facing in opposite directions and being spaced apart a distance less than the height of said side walls, surfaces of a pair also having a common opening adapted to receive a terminal screw that both mounts the contact module and makes electrical engagement with a lead, the mounting surfaces of a pair also being parallel to and substantially equidistant from a reference axis perpendicular to the direction of said reciprocating movement and midway between the outermost positions of the ends of said actuator stems.

2. In a contact module the combination comprising:

a housing including a pair of spaced side walls and a pair of ends joining said side walls;

a conductive terminal mounted on each of said ends with a stationary contact within said housing;

a slidable contact carrier mounting within said housing between said side walls for guided, reciprocating movement and having a contact cage with an actuator stem extending from both the top and the bottom;

a movable contact spanner mounted in and overhanging from the cage of said contact carrier, which spanner is movable toward and from said stationary contacts to bridge between them upon engagement therewith and to move between contact closed and contact open positions upon reciprocation of said contact carrier;

and a pair of conductive mounting surfaces forming upper and lower sides of each terminal which are disposed outward of said end portions with the surfaces of a pair facing in opposite directions and being spaced apart a distance less than the height of said side walls, surfaces of a pair also having a common opening extending therethrough, the mounting surfaces of a pair also being parallel to and substantially equidistant from a reference axis perpendicular to the direction of said reciprocating movement and midway between the outermost positions of the ends of said actuator stems.

3. In a contact module the combination comprising:

a housing having a contact chamber open at the top and bottom;

a pair of stationary contact members secured to said housing each having a stationary contact in the housing and a thin metal terminal portion with a mounting hole at the end of the housing;

a movable contact carrier reciprocably mounted in said contact chamber with a shoulder facing outward from each lower and upper end thereof and a stem protruding from each shoulder, the reciprocable movement of said carrier being between contact open and contact closed positions with one stem being at its remotest outer position from the contact chamber for each contact position;

movable contacts carried by said movable contact carrier that are positioned in said contact chamber for movement between closed and open positions with respect to said stationary contacts, thereto;

an operating spring encircling one of said stems working upon the shoulder associated with the stem;

an operating member engaging the opposite stem having a first position compressing said spring through said contact carrier and retractable from the first position, whereby said spring moves said contact carrier for contact operation;

and mounting surfaces for the module comprising upper and lower surfaces of said thin metal terminal portion, which mounting surfaces are equi-spaced from a reference line that is midway between the remotest outer positions of said stems.

4. In an assembly of contact modules having one module above the other, the combination comprising:

a lower module having:

a housing open through its center with an open top and bottom;

end portions forming a part of the housing;

a slidable contact carrier inserted in the housing for reciprocating motion therein, which carrier has an upper and lower stem protruding therefrom, such stems being of reduced cross section to form a working shoulder at the base of each stem; and

a conductive terminal fixed on each end portion that extends endwise from the module and has a thickness less than the height of the housing to present upper and lower mounting surfaces on opposite sides thereof that are adapted to engage lead wires and receive a terminal screw that secures the module in place;

a movable contact member supported by said contact carrier for travel therewith;

an upper module like said lower module oriented with the lower end of its lower stem resting upon the upper end of the upper stem of the lower module and with the mounting surfaces of its conductive terminals disposed inwardly of the mounting surfaces of the lower module;

a first operating spring encircling the upper stem of said lower module working against the working shoulder at the base of such stem; and

a second operating spring encircling the upper stem of the upper module working against the working shoulder at the base of such stem.

5. An assembly of contact modules as in claim 4 wherein the reciprocating motion of each slidable contact carrier defines the upper and lower extent of the positions of the ends of said stems, and the mounting surfaces of each conductive terminal are equidistant from a horizontal line through a point midway between the upper and lower extent of the stem positions.

6. In a contact module the combination comprising:

a contact carrier having a central box-like contact cage formed of a pair of spaced upright guide walls with an opening therebetween that are joined at one end by a cross rib and at the other end by a saddle rib that constitutes a contact seat; said contact carrier further having an actuator stem protruding from each rib which is of lesser cross section than the contact cage to form a working shoulder at the juncture of each stem with the cage;

a movable contact spanner inserted in said opening of said contact cage with contacts overhanging from the cage and with a center section formed to mate with said saddle rib for alignment with the contact carrier;

a contact bias spring inserted in said contact cage between said movable contact spanner and said cross rib which urges the movable contact spanner toward said saddle rib;

a module housing receiving said contact carrier that has:

spaced side walls in bearing engagement with said guide walls of said contact carrier for sliding movement of the contact carrier;

end portions joining the side walls to form a housing with the side walls that is open at the top

and bottom and from which the actuator stems of the contact carrier protrude, and

stationary contact members mounted on said end portions of said module housing, which extend endwise from the housing with a conductive mounting portion of depth less than the height of said housing with mounting surfaces on opposite sides thereof for mounting the module in either of inverse positions.

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KATHLEEN H. CLAFFY, *Primary Examiner.*

BERNARD A. GILHEANY, *Examiner.*